NANAKULI SUBDIVISION - PHASE I
PRELIMINARY SOIL REPORT

NANAKULI, OAHU, HAWAII
TAX MAP KEY: 8-9-07: 3

To:
WILSON, OKAMOTO & ASSOCIATES, INC.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DECEMBER 12, 1973

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE
WALLACE WAKAHIRO
3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • TEL. 737-7931

December 12, 1973

WILSON, OKAMOTO & ASSOCIATES, INC.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814

Gentlemen:

Subject: Nanakuli Subdivision - Phase I
Preliminary Soil Report
(site grading for residential development)
Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

Transmitted herewith is our preliminary soil report for site grading for residential development purposes for the proposed Nanakuli Subdivision - Phase I.

This report includes a Boring Location Sketch, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

SHL/EK:rmf

C O N T E N T S

NANAKULI SUBDIVISION - PHASE I
PRELIMINARY SOIL REPORT

NANAKULI, OAHU, HAWAII
TAX MAP KEY: 8-9-07: 3

SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading for residential development for the proposed Nanakuli Subdivision - Phase I at Nanakuli, Oahu, Hawaii.

This report includes field explorations, laboratory tests and general recommendations for site grading design considerations and limitations.

FIELD EXPLORATION AND LABORATORY TESTS

Thirteen exploratory borings and 5 logs of existing slopes were made at the site. The approximate locations of these borings and slope logs are shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on the boring logs.

Borings were made with 4-in. diameter augers using finger type bits. Soil samples were recovered with a 2-in. o.d. standard split spoon sampler driven with a 140-lb hammer falling 30 inches.

Laboratory tests included: natural water content, Atterberg limit, grain-size analysis, specific gravity, AASHO T-180-73I density and CBR.

A summary of the laboratory test results is given in Tables IA thru IF.

SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GEOLOGIC AND SOIL CLASSIFICATIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils may be generally described as noncalcareous deposits.

Stearns, H. T. and U. S. Geological Survey "Geologic and Topographic Map, Island of Oahu, USGS 1938:"

Pa - Consolidated noncalcareous deposits

Ra - Unconsolidated noncalcareous deposits

U. S. Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August, 1972:

EaB - Ewa silty clay loam (ML or CL soils), 3 to 6% slopes

LPE - Lualualei extremely stony clay (CH soils), 3 to 35% slopes

PvC - Pulehu very stony clay loam (CL, SM or ML soils), 0 to 12% slopes

GENERAL SITE CONDITIONS

The proposed residential site is located between Nanakuli High School and the Tongg Ranch in Nanakuli Valley. The site is about 1/2 mile northeast (mauka) of Farrington Highway. The site is on the west side of Nanakuli Stream.

The existing ground slopes down in a southerly direction at about 5 to 15% gradients with localized variations. In some areas near the Nanakuli Stream, slopes as steep as about 65% (1-1/2:1) were noted.

An existing paved road that is an extension of Nanakuli Avenue is on the eastern section of the site. Dirt roads were also noted.

An occupied wooden house, a quonset hut and a few sheds are located on the northeast part of the site. Wire fences were observed on the northeastern border and along the stream.

The site is generally covered by tall grass, brush and trees with some abandoned cars and rubbish. Scattered cobbles and boulders were noted on the site, especially by the steep slopes near Nanakuli Stream.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

A mixture of stiff dark brown to gray brown clays (CH), boulders, cobbles and decomposed rock with localized

pockets of reddish-brown clayey silt to about 8 to 20 ft, the depths drilled.

The drilled depths in Boring Nos. 4, 7, 11A and 14 were less than 6 ft due to boulder or decomposed rock encountered at the bottom of the drilled holes. Three or more attempts were made to drill thru the surface layer of cobble, boulders and decomposed rock at each of the boring locations.

The soils exposed on the stream cut slopes may be generally approximated as sandy silts and silty clays with boulders, cobbles and decomposed rock interspersed in the layers.

Water was not noted in the borings during the field explorations.

Variations to the above soil conditions are to be expected. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to clear and grade the site for residential development. The preliminary plan generally indicates cuts to about 16 ft and fills to about 32 ft in some areas.

Since cobbles, boulders and decomposed rock were encountered near the surface in most borings, boulders and cobbles may be anticipated in most cuts. The deeper the cut, the greater quantity of boulders might be expected. If large quantities of cobbles and boulders are encountered during the grading work, a disposal site for the boulders and a source of off-site borrow may have to be considered. Boulders may be used to construct fill slopes away from building locations. Filter blankets of granular material should be placed between the boulder fills and natural or compacted earth fills. See Figure 1.

Because there is an occupied house and an existing road to the site, utility lines, cesspools, etc., may be encountered during clearing, grubbing and excavating operations.

Because of surface clay soils, the overall site grading design should consider the use of low and fairly gentle slopes. In sloping areas, grading design may consider excavating upper areas to remove driving forces and filling lower areas for resistance to downhill movement.

Site Grading

Surface vegetation and miscellaneous debris, abandoned cars and rubbish should be cleared and removed prior to site filling. Localized soft pockets encountered during site preparations should be excavated and replaced with

select soils compacted in thin lifts. Cesspools encountered during demolition and grubbing work should be backfilled as recommended under "Cesspools."

Provisions to drain the site should be included during and after the completion of filling operations.

Grading work should be done in accordance with the Revised Ordinances of Honolulu, 1969 As Amended and as recommended below:

1. The area should be cleared and grubbed.

2. Topsoil should be stripped to stiff natural ground before the placement of fills.

3. Hard surfaces such as along the existing unpaved road should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

4. Use of clay soils in fills on sloping areas should be avoided. On-site clay soils should generally be placed in the deeper portions of fills in flatter areas and away from the faces of slopes. Selected on-site soils or

borrow soils should be placed in the upper 2 ft of fills and in the outer portions of slopes, if practicable.

5. Fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should continually be keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

6. If boulders are proposed to be used in the construction of fills, they should be generally placed along the toe sections of fill slopes and outside of probable building sites. Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A layer of select material or low grade concrete should be placed on the subgrade and

the boulders placed on the select material or low grade concrete. The void spaces between boulders should be filled with smaller granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 1.

7. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-73-I test method. In roadway areas, the top 2 ft of fill should be compacted to 95% of the maximum density.

8. Provisions to drain the site should be included during and after the completion of filling operations.

Slopes

In general, cut and fill slopes of 3 horizontal to 1 vertical or flatter should be used for slopes less than about 6 ft in height in clay (CH) soils; otherwise, 2:1 slopes may be considered with removal of clay soils from the outer portion of slope and replacement with select soils.

Flatter slopes should generally be considered for higher slopes in the clay (CH) soils; otherwise, buttress slopes

with select materials should be considered. See attached sketch, Figure 2.

If slope heights (top to toe) greater than 15 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft.

To minimize erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize erosion.

Slope adjustments or other precautions may be necessary if seepage zones or expansive clay pockets are encountered in localized areas.

Foundations

Because the surface soils at the site are generally clays (CH) and silty clays (CH-MH) that would tend to shrink and swell with moisture variations, post-and-beam type foundations are generally recommended.

To minimize the effects of heave and shrinkage of "CH" and "CH-MH" soils, excavations for the foot blocks should be made about 2 ft deep and about 1 ft 6 in. square or round and backfilled with compacted, select coral or an equivalent non-expansive granular material. The foot blocks may be placed on top of the select material. See Figure 3.

The select coral or granular material should be 1-1/2 in. to dust sizes with about 20% passing the No. 200 sieve.

If slab-on-ground construction is used on clayey soils (CH and CH-MH), the lot should be graded such that there will be a 2-ft layer of select coral or selected borrow material below the building area and extending about 3 ft beyond the perimeter of the building. The clay soils should be kept moist and not allowed to dry before placing and compacting the select material.

General guidelines for foundation design considerations may be as follows:

1. Bearing values for a given soil usually vary with the size and depth of footings. For

light, residential structures, bearing values of about 2000 p.s.f. may be used for footings resting on stiff natural ground or on compacted fill.

2. Soft spots or pockets of loose material encountered in footing excavations or below the building area should be excavated and replaced with select well-graded coral or granular material compacted in thin lifts.

3. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings should generally be placed about 15 ft from the tops of slopes.

4. Construction of retaining walls on slopes should generally be avoided.

5. Good surface drainage away from the foundation of structures should be maintained and the site should be graded to prevent the ponding of water.

Roadway

In general, for the light automobile traffic and drained subgrade conditions, an estimate of the roadway pavement thickness may be as follows:

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course.
3. Subbase course - 6-in. subbase course.
4. Borrow - 18-in. select borrow soil over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding select borrow subbase and borrow requirements in the field in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade, weep holes should be placed at subgrade levels thru the walls of the catch basins.

Cesspools

Cesspools may be encountered during the site preparation work. When encountered, cesspools should be flagged and located on the plans. Sludge should be removed from the bottom and the cesspool backfilled with fairly well-graded granular materials. The materials should be placed in thin layers and rammed into place or compacted with vibratory equipment. The top 4 ft of fill should be compacted in 6-in. compacted layers.

Building foundations should be designed to bridge the cesspool.

Utilities

Utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

Unforeseen Conditions

Because of the variability of soil deposits, site improvements, designs and construction techniques, conditions may be encountered that cannot be foreseen with even the most exhaustive studies of site and project conditions. These unforeseen conditions should be recognized and then evaluated so that the designs or the construction methods may be modified accordingly, if necessary.

Unforeseen or undetected conditions such soft spots, existing utility trenches, structure foundations, voids or cavities, old tunnels, boulders, expansive soil pockets or seepage water, etc., may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

Site Regrading

After mass grading work is done and cuts and fills are made according to the grading plans, regrading at some future date should be avoided unless done under the guidance of a soils engineer.

PROPOSED SPECIFICATION FOR EARTHWORK

NANAKULI SUBDIVISION - PHASE I

General Description

This item shall consist of clearing and grubbing, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work for grading the site.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, rubbish and miscellaneous material shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Topsoil and stockpiled soils shall be stripped to stiff natural ground before the placement of fills. Loose surface soils encountered at finish grade shall be scarified and recompacted.

Hard surfaces of the existing dirt road shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

Materials

Fill material shall consist of selected on-site soils or approved borrow soils. The soils shall contain no more than a trace of organic and deleterious matter.

Borrow soils shall be select soils generally less than 6-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest, and voids between rocks shall be filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content is near the optimum.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-73I or other comparable density tests. For fills in roadway areas, the top 2 ft of fill shall be compacted to 95% of the maximum density. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area, and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of a layer of fill or portion thereof is below the required density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Boulder Fills

If boulders are used for the construction of fills, they shall be generally placed along the toe section of slopes. The subgrade shall be stripped to stiff natural ground, shaped to drain and a layer of select material or low grade concrete shall be placed on it. Voids shall be filled with smaller granular soils. A blanket of filter material shall be placed against the boulder fill before construction of fills against it.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc., are encountered, corrective measures shall be made in the field as they are detected.

Rainy Weather

Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests indicate that the water content and density are as previously specified.

BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or sieve analysis test results.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 1 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: Nov. 5, 1973
Field Party: METER, SHIGENAGA
Type of Boring: AUGER (MOBILE B-40) Diam.: 4"
Elev.: 225'± * Datum: -
Drill Bit: FINGER TYPE

Water Level	NOT NOTICED				
Time	-				
Date	11-5-73				

Unified Soil Classification	DRILL RATE	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
		ELEV. = 225'± *	0								
CH	0.5 - 6.0' 20 MIN.	DARK BROWN CLAY W/ GRAVEL									
			5								
		COBBLES OR BOULDERS			1-A	NO	RECOVERY				40/0.2'
		END OF BORING @ 9.5' 11-5-73	10								
		NOTE: DRILLED 3 HOLES.									

* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 2 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date NOV. 5 & 19, 1973

Field Party RADOVICH, SHIGENAGA, KAKU, MEYER

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. ____ Datum ____

Drill Bit FINGER TYPE

Water Level					
Time	–				
Date	11-19-73				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
(CH)	STIFF, MOTTLED BROWN SANDY CLAY W/ DECOMPOSED ROCK	0								
	COBBLES, BOULDERS			2-A	–	13	–	–	–	30/0.2'
		5		2-B	ROCK FRAGMENTS					40/0.0' HAMMER BOUNCES
	CLAY OR SAND SILT (?)									
		10		2-C	–	7	–	–	–	35/0.1' HAMMER BOUNCES
(CH)	MOTTLED BROWN CLAY W/SAND GRAVEL & DECOMPOSED ROCK	15		2-D	–	10	–	–	–	50/0.4' HAMMER BOUNCES
	END OF BORING @ 15.4' 11-19-73									
	NOTE: HIT COBBLE OR BOULDER AT 1.5', 11-5-73. MOVED HOLE. SECOND ATTEMPT 11-19-73									

* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

LOG OF SLOPE NO. 3 A Sheet No. ____ of ____

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

Driller W. LUM ASSOC., INC. Date Nov. 16, 1973

Field Party LAI

Type of Boring STREAM CUT SLOPE Diam. ____

Elev. 170'± * Datum —

Drill Bit ____

HAMMER:

Weight ____

Drop ____

SAMPLER: ____

Water Level				
Time	—			
Date	11-16-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	TOP OF SLOPE ↓ ELEV. = 170'± * ↓	0								
(GM)	BOULDERS & COBBLES W/SOME DARK REDDISH BROWN CLAYEY SILT			A	—	11	—	—	—	
		5								
SM	BROWN SILTY SAND W/GRAVEL & COBBLES			B	—	15	—	—	—	
		10								
(GM)	TAN BROWN & MOTTLED GRAY DECOMPOSED ROCK W/SILTY SAND			C	—	13	—	—	—	
		15								
	BOTTOM OF SLOPE @ 17'± STREAM BED 11-16-73									

* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

HANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

LOG OF SLOPE

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:

Weight

Drop

SAMPLER:

~~BORING~~ NO. 3B Sheet No. of

Driller W. LUM ASSOC., INC. Date NOV. 16, 1973

Field Party LAI

Type of Boring STREAM CUT SLOPE Diam. –

Elev. 170'± * Datum

Drill Bit

Water Level					
Time	–				
Date	11-16-73				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	TOP OF SLOPE ↓ ELEV.= 170'± ↓ *	0								
GW-GM	REDDISH BROWN SILTY SAND, GRAVEL & COBBLES			A	–	10	–	–	–	
		5								
(CH)	TANNISH GRAY & MOTTLED REDDISH BROWN CLAY W/ SAND GRAVEL, COBBLES & DECOMPOSED ROCK			B	–	13	–	–	–	
		10								
CH	MOTTLED REDDISH BROWN & GRAY, CLAY W/ SILTY SAND POCKETS, GRAVEL, COBBLES & SOME DECOMPOSED ROCK			C	–	13	–	–	–	
						LL= 66				
		15				PL= 31				
	BOTTOM OF SLOPE @ 16'± STREAM BED 11-16-73									

NOTE:
LL= LIQUID LIMIT
PL= PLASTIC LIMIT

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 4 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: NOV. 2, 1973
Field Party: MEYER, SHIGENAGA
Type of Boring: AUGER (MOBILE B-40) Diam.: 4"
Elev.: 212'± * Datum: -
Drill Bit: FINGER TYPE

Water Level	NOT NOTICED			
Time	-			
Date	11-2-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 212'± *	0								
CH	STIFF, REDDISH BROWN CLAY			4-A	-	19	-	-	-	41
						LL = 70				
	BOULDER					PL = 24				
	END OF BORING @ 4' 11-2-73	5								
	NOTE: DRILLED 3 HOLES TO 3.5' DEPTH.									
					NOTE					
					LL= LIQUID LIMIT					
					PL= PLASTIC LIMIT					

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 6 Sheet No. ____ of ____
Driller W. LUM ASSOC., INC. Date NOV. 5 & 20, 1973
Field Party RADOVICH, SHIGENAGA, KAKU, MEYER
Type of Boring AUGER (MOBILE B-40) Diam. 4"
Elev. 216'± * Datum —
Drill Bit FINGER TYPE

Water Level	NOT NOTICED				
Time	—				
Date	11-20-73				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 216'± *	0								
	STIFF, BROWN, CLAY			G-A	—	10	—	—	—	20/0.1'
	COBBLE & BOULDER W/ CLAY POCKETS	5		G-B	—	13	—	—	—	50/0.4' HAMMER BOUNCES
	COBBLES OR BOULDERS W/ MOTTLED BROWN CLAY, SAND & DECOMPOSED ROCK	10		G-C	—	17	—	—	—	50/0.3' HAMMER BOUNCES
	BROWN, SILTY SAND W/ GRAVEL	15		G-D	—	11	—	—	—	50/0.5' HAMMER BOUNCES
	END OF BORING @ 17.5' 11-20-73									

NOTE: HIT COBBLE OR BOULDER AT 1.5', 11-5-73. MOVED HOLE. SECOND ATTEMPT 11-20-73.

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 7 Sheet No. ____ of ____
Driller W. LUM ASSOC., INC. Date NOV. 5, 1973
Field Party MEYER, SHIGENAGA
Type of Boring AUGER (MOBILE B-40) Diam. 4"
Elev. 214'± * Datum —
Drill Bit FINGER TYPE

Water Level	NOT NOTICED			
Time	—			
Date	11-5-73			

Unified Soil Classification	Drill Rate	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
		ELEV. = 214'± *	0								
ML-CL	0.5' - 5.0' 25 MIN.	REDDISH BROWN SILTY CLAY									
		COBBLES OR BOULDER									
			5								
		END OF BORING @ 5' 11-5-73									

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 8 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: Nov. 5, 1973
Field Party: MEYER, SHIGENAGA
Type of Boring: AUGER (MOBILE B-40) Diam.: 4"
Elev.: 198'± * Datum: —
Drill Bit: FINGER TYPE

Water Level				
Time	—			
Date	11-5-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV.= 198'± *	0								
ML	STIFF MOTTLED REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK			B-A	—	18 LL= 46 PL= 29	—	—	—	
	COBBLE OR BOULDER	5								
(CH)	STIFF, BROWNISH GRAY CLAY W/ DECOMPOSED ROCK			B-B	—	21	—	—	—	50/0.5'
	COBBLES OR BOULDERS	10		B-C	NO RECOVERY					40/0.1'
	END OF BORING @ 15' 11-5-73	15								

NOTE
LL= LIQUID LIMIT
PL= PLASTIC LIMIT

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

LOG OF SLOPE NO. 10 A Sheet No. _____ of _____

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

Driller W. LUM ASSOC., INC. Date NOV. 16, 1973

Field Party LAI

Type of Boring STREAM CUT SLOPE Diam. _____

Elev. 124'± * Datum —

Drill Bit _____

HAMMER:

Weight _____

Drop _____

SAMPLER: _____

Water Level	NOT NOTICED		
Time	—		
Date	11-16-73		

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	TOP OF SLOPE ↓ ELEV.= 124'± * ↓	0								
ML CL	REDDISH BROWN, SILTY CLAY			A	—	16	—	—	—	
	GRAY, CLAYEY SILT W/ GRAVEL & COBBLES					LL= 49				
						PL= 28				
	COBBLES & GRAVEL W/ BROWN, SILTY SAND			B	—	2	—	—	—	
		5								
	BOULDERS, COBBLES & GRAVEL W/ SOME SANDY SILT				NOTE					
					LL=	LIQUID	LIMIT			
					PL=	PLASTIC	LIMIT			
		10								
	BOTTOM OF SLOPE @ 10'± 11-16-73									

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

LOG OF SLOPE ~~BORING~~ NO. 10 B Sheet No. _____ of _____

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

Driller W. LUM ASSOC., INC. Date Nov. 16, 1973

Field Party LAI

Type of Boring STREAM CUT SLOPE Diam. _____

Elev. 130'± * Datum —

Drill Bit _____

HAMMER:

Weight _____

Drop _____

SAMPLER: _____

	Water Level				
	Time	—			
	Date	11-16-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	TOP OF SLOPE ↓ ELEV. = 130'± ↓ *	0								
	BOULDERS, COBBLES & GRAVEL									
GW	TAN BROWN GRAVEL W/SAND, COBBLES & BOULDERS	5		A	-	7	-	-	-	
	BOTTOM OF SLOPE @ 10'± 11-16-73	10								

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

LOG OF SLOPE NO. 10C Sheet No. _____ of _____

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

Driller W. LUM ASSOC., INC. Date NOV. 16, 1973

Field Party LAI

Type of Boring STREAM CUT SLOPE Diam. _____

Elev. 130'± * Datum —

Drill Bit _____

HAMMER:

Weight _____

Drop _____

SAMPLER: _____

Water Level	NOT NOTICED			
Time	—			
Date	11-16-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	TOP OF SLOPE ↓ ELEV.= 130'± * ↓	0								
SM	REDDISH BROWN SILTY SAND W/ GRAVEL & COBBLES			A	—	11	—	—	—	
	MOTTLED BROWN & GRAY SILTY SAND & DECOMPOSED ROCK	5		B	—	10	—	—	—	
(SM)	BROWN & REDDISH BROWN SILTY SAND W/ GRAVEL & COBBLES	10		C	—	6	—	—	—	
	BOTTOM OF SLOPE @ 16'± 11-16-73	15								

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 11 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date NOV. 19, 1973

Field Party RADOVICH, SHIGENAGA, KAKU

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 202'± * Datum —

Drill Bit FINGER TYPE

Water Level NOT NOTICED

Time —

Date 11-19-73

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 202'± *	0								
CH	STIFF, DARK BROWN CLAY W/ DECOMPOSED ROCK			11-A	—	17	—	—	—	65
						LL= 85				
						PL= 28				
	MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK									
	COBBLES OR BOULDERS	5		11-B	NO RECOVERY					40/0.0'
	END OF BORING @ 8' 11-19-73									
					NOTE					
					LL= LIQUID LIMIT					
					PL= PLASTIC LIMIT					

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:

Weight

Drop

SAMPLER:

BORING NO. 11A Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date NOV. 7, 1973

Field Party MEYER, KAKU, SHIGENAGA

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 196'± * Datum —

Drill Bit FINGER TYPE

Water Level	NOT NOTICED				
Time	—				
Date	11-7-73				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 196'± *	0								
	DARK BROWN, CLAY									
	LIGHT BROWN									
	DECOMPOSED ROCK	2'			DRILL 1.5' - 2.0'		TIME 20 MIN.			
	COBBLE OR BOULDER									
	END OF BORING @ 2' 11-7-73									
	NOTE: MOVED HOLE AND HIT BOULDER AT 2'									

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 12 Sheet No. ____ of ____
Driller W. LUM ASSOC., INC. Date NOV. 6 & 20, 1973
Field Party RADOVICH, SHIGENAGA, KAKU, MEYER
Type of Boring AUGER (MOBILE B-40) Diam. 4"
Elev. 202'± * Datum —
Drill Bit FINGER TYPE

Water Level					
	NOT NOTICED				
Time	—				
Date	11-20-73				

Unified Soil Classification	DESCRIPTION (Elev. = 202'± * 0)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
(ML)	STIFF, REDDISH BROWN CLAYEY SILT			12-A	-	17	-	-	-	40/0.4'
		5		12-B	-	15	-	-	-	45/0.4'
CH(GC)	COBBLES OR BOULDERS W/MOTTLED BROWN CLAY, SAND & DECOMPOSED ROCK					LL= 52 PL= 27				HAMMER BOUNCES
		10		12-C	-	10	-	-	-	40/0.4' HAMMER BOUNCES
	COBBLES OR BOULDERS W/BROWN, SILTY SAND & GRAVEL	15		12-D	-	9	-	-	-	40/0.1' HAMMER BOUNCES
	COBBLES OR BOULDERS W/MOTTLED BROWN CLAY & SAND	20		12-E	-	10	-	-	-	40/0.3' HAMMER BOUNCES
	END OF BORING @ 20.3' 11-20-73									

NOTE
LL= LIQUID LIMIT
PL= PLASTIC LIMIT

NOTE: HIT COBBLE OR BOULDER AT 6.0', 11-6-73. MOVED HOLE. SECOND ATTEMPT 11-20-73.

* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 13 Sheet No. ____ of ____
Driller W. LUM ASSOC., INC. Date NOV. 6 & 16, 1973
Field Party RADOVICH, SHIGENAGA, KAKU, MEYER
Type of Boring AUGER (MOBILE B-40) Diam. 4"
Elev. 199'± * Datum —
Drill Bit FINGER TYPE

Water Level					
Time	—				
Date	11-16-73				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV.= 199'± *	0								
	DARK BROWN CLAYS & COBBLES LIGHT BROWN DECOMPOSED ROCK									
		5		13-A	–	11	–	–	–	50/0.3' HAMMER BOUNCES
	COBBLES OR BOULDERS W/MOTTLED BROWN CLAYEY SILT W/SAND	10		13-B	–	8	–	–	–	50/0.2' HAMMER BOUNCES
		15		13-C	–	7	–	–	–	50/0.4' HAMMER BOUNCES
		20		13-D	–	7	–	–	–	50/0.4' HAMMER BOUNCES
	END OF BORING @ 20.4' 11-16-73									
	NOTE: HIT COBBLE OR BOULDER AT 2.5' 11-6-73. MOVED HOLE SECOND ATTEMPT 11-16-73.									

* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 14 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date NOV. 6, 1973

Field Party MEYER, SHIGENAGA

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 190'± * Datum —

Drill Bit FINGER TYPE

Water Level				
Time	—			
Date	11-6-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 190'± *	0								
	GRAY & LIGHT BROWN DECOMPOSED ROCK			14-A		17				30/0.2' HAMMER BOUNCES
	BOULDER W/ DECOMPOSED ROCK LAYER	5								
	END OF BORING @ 5.5' 11-6-73									
	NOTE: MOVED HOLE 5 TIMES. 5.5' DEEPEST PENETRATION									

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 15 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: NOV. 6, 1973
Field Party: MEYER, SHIGENAGA
Type of Boring: AUGER (MOBILE B-40) Diam.: 4"
Elev.: 190'± * Datum: —
Drill Bit: FINGER TYPE

Water Level	NOT NOTICED			
Time	—			
Date	11-6-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 190'± *	0								
CH	STIFF MOTTLED REDDISH BROWN CLAY W/ DECOMPOSED ROCK			15-A	-	18 LL= 63 PL= 25	-	-	-	
	COBBLES OR BOULDERS	5		15-B	No RECOVERY					40/0.2'
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT	10		15-C	-	17	-	-	-	30/0.3'
SM	DENSE, BROWN SILTY SAND W/GRAVEL	15		15-D	-	5	-	-	-	46
	END OF BORING @ 17' 11-6-73									

NOTE
LL= LIQUID LIMIT
PL= PLASTIC LIMIT

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT NANAKULI SUBDIVISION - PHASE I

LOCATION Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 16 Sheet No. _____ of _____

Driller W. LUM ASSOC., INC. Date NOV. 2, 1973

Field Party MEYER, SHIGENAGA

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 188'± * Datum _____

Drill Bit FINGER TYPE

Water Level					
Time					
Date					

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 188'± *	0								
(CH)	STIFF, REDDISH BROWN CLAY W/ DECOMPOSED ROCK			16-A	–	19	–	–	–	44
	COBBLE OR BOULDER	5								
SM	DENSE, BROWN SILTY SAND W/ GRAVEL			16-B	–	14	–	–	–	50/0.4"
	END OF BORING @ 8' 11-2-73									

*Elev. Estimated from Topo. Map by Wilson, Okamoto & Assoc., Inc.

NANAKULI SUBDIVISION - PHASE I

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	3A	3B	3B
SAMPLE NO.		B	A	C
DEPTH BELOW SURFACE	SURFACE	4'-9'	0'-4'	10'-16'
DESCRIPTION	DARK BROWN CLAY W/SOME GRAVEL & ROOTS	BROWN SILTY SAND W/GRAVEL & COBBLES	REDDISH-BROWN SILTY SAND, GRAVEL & COBBLES	MOTTLED REDDISH-BROWN & GRAY CLAY W/SILTY SAND POCKETS, GRAVEL, COBBLES & DECOMP. ROCK
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve 1½"		100	100	
1"		86.3	86.6	
1/2"		79.4	71.7	
#4		69.8	52.5	
#10		59.9	37.9	
#20		41.0	24.4	
#40		27.6	16.1	
#100		19.7	9.8	
#200		18.0	8.2	
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL			NATURAL
Liquid Limit	64			66
Plastic Limit	27			31
Plasticity Index	37			35
Dilatancy	SLOW			SLOW-MED.
Toughness	MED.-HIGH			MED.-HIGH
Dry Strength	HIGH			MED.-HIGH
UNIFIED SOIL CLASSIFICATION	CH	SM	GW-GM	CH
APPARENT SPECIFIC GRAVITY				
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By BT

NANAKULI SUBDIVISION - PHASE I

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	4	6	7	
SAMPLE NO.	A			
DEPTH BELOW SURFACE	1'-2.5'	SURFACE	SURFACE	
DESCRIPTION	REDDISH-BROWN CLAY	BROWN CLAY	REDDISH-BROWN SILTY CLAY	
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve 1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	
Liquid Limit	TO	97	47	
Plastic Limit	24	31	27	
Plasticity Index	46	66	20	
Dilatancy	SLOW	SLOW	SLOW-MED.	
Toughness	HIGH	HIGH	MEDIUM	
Dry Strength	HIGH	HIGH	MED.-HIGH	
UNIFIED SOIL CLASSIFICATION	CH	CH	ML-CL	
APPARENT SPECIFIC GRAVITY				
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %		25.4		
Molding Dry Density, P.C.F.		93.9		
Swell upon saturation, %		11.8		
CBR at 0.1" Penetration		1.3		
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By BT

3-1273

NANAKULI SUBDIVISION - PHASE I

TABLE I C - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	8	8	10A	10B
SAMPLE NO.		A	A	A
DEPTH BELOW SURFACE	SURFACE	1'-2.5'	0'-0.5'	3'-10'
DESCRIPTION	MOTTLED REDDISH-BROWN CLAYEY SILT	MOTTLED REDDISH-BROWN CLAYEY SILT W/DECOMP. ROCK	REDDISH-BROWN SILTY CLAY	TAN-BROWN GRAVEL W/SAND, COBBLES & BOULDERS
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve 1½"				100
1"				80.3
1/2"				60.0
#4				40.0
#10				25.5
#20				13.1
#40				8.0
#100				5.6
#200				4.9
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	
Liquid Limit	45	46	49	
Plastic Limit	27	29	28	
Plasticity Index	18	17	21	
Dilatancy	MED.-QUICK	MEDIUM	MEDIUM	
Toughness	MEDIUM	SLIGHT-MED.	MEDIUM	
Dry Strength	MEDIUM	SLIGHT-MED.	MEDIUM	
UNIFIED SOIL CLASSIFICATION	ML-CL	ML	ML-CL	GW
APPARENT SPECIFIC GRAVITY	3.02			
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %	21.8			
Molding Dry Density, P.C.F.	104.1			
Swell upon saturation, %	0.3			
CBR at 0.1" Penetration	41.6			
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-73I, Method ___)	A			
Dry to Wet or Wet to Dry	DRY TO WET			
Max. Dry Density (P.C.F.)	105			
Optimum Moisture (%)	22			

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By BJT

NANAKULI SUBDIVISION - PHASE I

TABLE I D - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	10C	11	12	13
SAMPLE NO.	A	A	B	
DEPTH BELOW SURFACE	0'-4'	0.5'-2'	5'-5.9'	SURFACE
DESCRIPTION	REDDISH-BROWN SILTY SAND W/GRAVEL & COBBLES	DARK BROWN CLAY W/DECOMP. ROCK	COBBLES OR BOULDERS W/MOTTLED BROWN CLAY, SAND & DECOMP. ROCK	DARK BROWN CLAY
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"	100			
1/2"	82.7			
#4	67.3			
#10	54.2			
#20	41.9			
#40	35.0			
#100	28.3			
#200	26.2			
ATTERBERG LIMITS				
Air Dried or Natural		NATURAL	NATURAL*	NATURAL
Liquid Limit		85	52	113
Plastic Limit		28	27	34
Plasticity Index		57	25	79
Dilatancy		SLOW	SLOW-MED.	SLOW
Toughness		MED.-HIGH	MEDIUM	HIGH
Dry Strength		HIGH	MED.-HIGH	HIGH
UNIFIED SOIL CLASSIFICATION	SM	CH	CH (GC)**	CH
APPARENT SPECIFIC GRAVITY				2.88
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %				30.0
Molding Dry Density, P.C.F.				92.9
Swell upon saturation, %				10.4
CBR at 0.1" Penetration				1.6
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)				A
Dry to Wet or Wet to Dry				DRY TO WET
Max. Dry Density (P.C.F.)				95
Optimum Moisture (%)				28

REMARKS:
* SAMPLE TESTED ONLY ON THAT PORTION THAT PASSES THE #40 SIEVE.
** UNIFIED SOIL CLASSIFICATION IN PARENTHESIS BASED ON VISUAL IDENTIFICATION OF TOTAL SAMPLE.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By RT

3-1273

NANAKULI SUBDIVISION - PHASE I

TABLE I E - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	14	15	15	15
SAMPLE NO.			A	D
DEPTH BELOW SURFACE	SURFACE	SURFACE	1'-2.5'	15'-16.5'
DESCRIPTION	BROWN CLAY	REDDISH-BROWN SILTY CLAY W/DECOMP. ROCK	MOTTLED REDDISH-BROWN CLAY W/DECOMP. ROCK	BROWN SILTY SAND W/GRAVEL
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"				100
1/2"				100
#4				80.3
#10				69.0
#20				60.5
#40				55.4
#100				47.8
#200				41.4
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL		NATURAL	
Liquid Limit	67		63	
Plastic Limit	27		25	
Plasticity Index	40		38	
Dilatancy	SLOW		SLOW	
Toughness	MED.-HIGH		MED.-HIGH	
Dry Strength	HIGH		HIGH	
UNIFIED SOIL CLASSIFICATION	CH		CH	SM
APPARENT SPECIFIC GRAVITY		2.98		
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %	20.4	20.0		
Molding Dry Density, P.C.F.	102.9	105.0		
Swell upon saturation, %	8.9	1.7		
CBR at 0.1" Penetration	1.5	7.8		
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)		A		
Dry to Wet or Wet to Dry		DRY TO WET		
Max. Dry Density (P.C.F.)		104		
Optimum Moisture (%)		22		

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By BT

3-1273

NANAKULI SUBDIVISION - PHASE I

TABLE I F - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	16			
SAMPLE NO.	B			
DEPTH BELOW SURFACE	5'-5.9'			
DESCRIPTION	BROWN SILTY SAND W/GRAVEL			
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve				
1"	100			
1/2"	100			
#4	92.2			
#10	81.8			
#20	70.0			
#40	59.3			
#100	43.6			
#200	37.8			
ATTERBERG LIMITS				
Air Dried or Natural				
Liquid Limit				
Plastic Limit				
Plasticity Index				
Dilatancy				
Toughness				
Dry Strength				
UNIFIED SOIL CLASSIFICATION	SM			
APPARENT SPECIFIC GRAVITY				
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

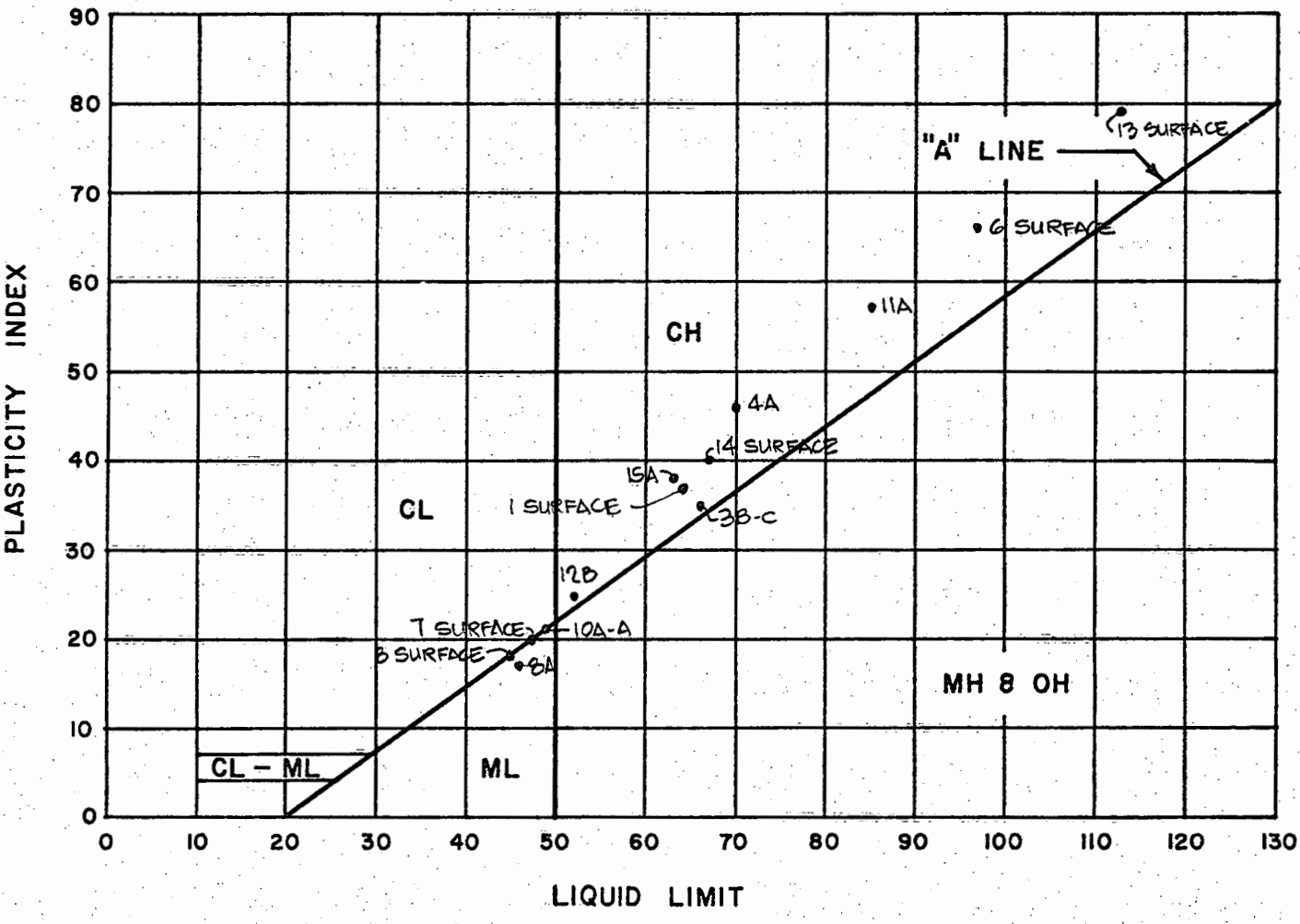
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 12-11-73 By BT

PLASTICITY CHART

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII



DATE 12-11-73 BY BT

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

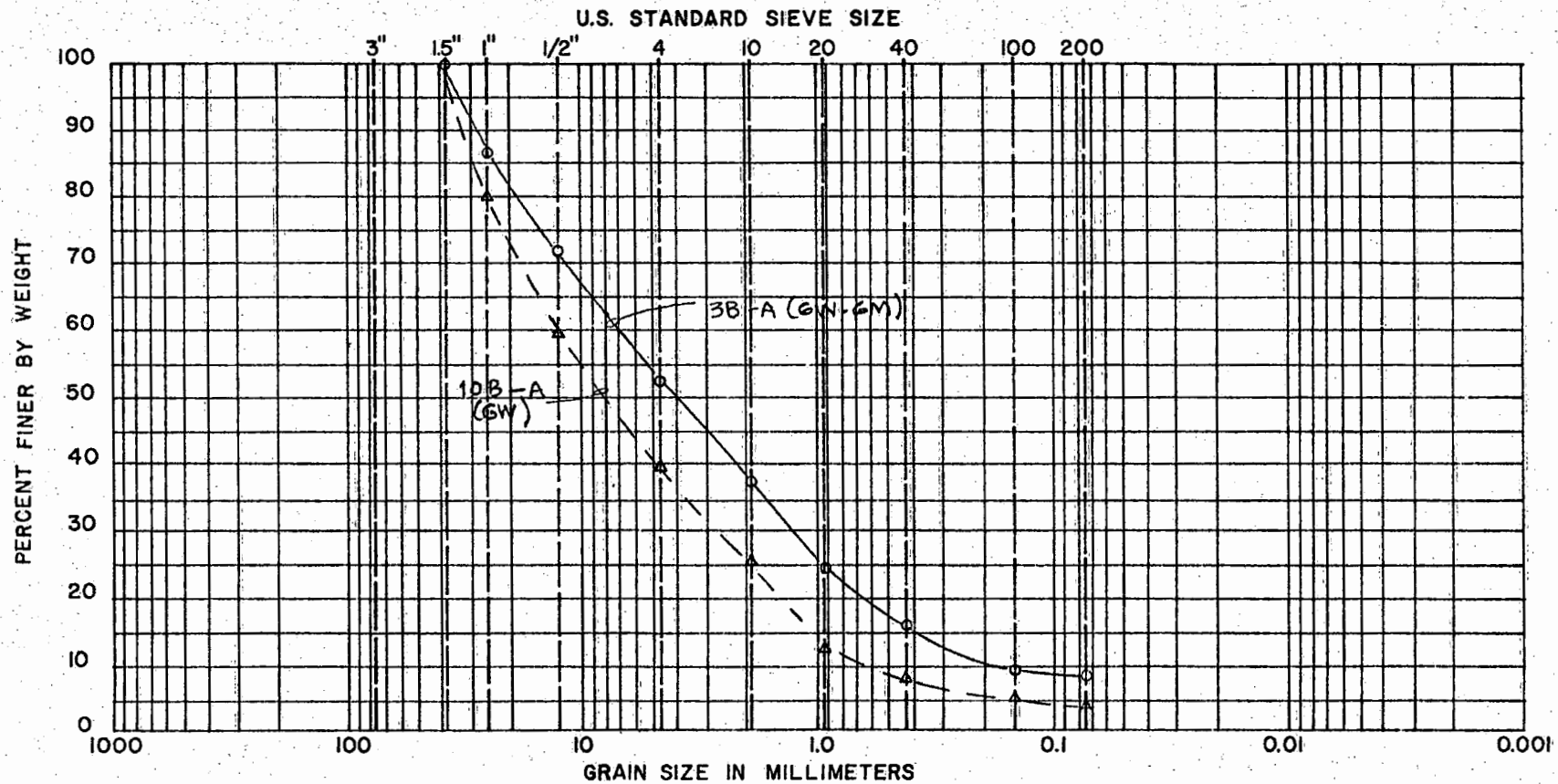
8-872

13-570

GRAIN-SIZE ANALYSIS CURVE

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII



COBBLE	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

DATE 12-11-73 BY BT.

MOISTURE–DENSITY CURVE (AASHO T-180-73I, METHOD A)

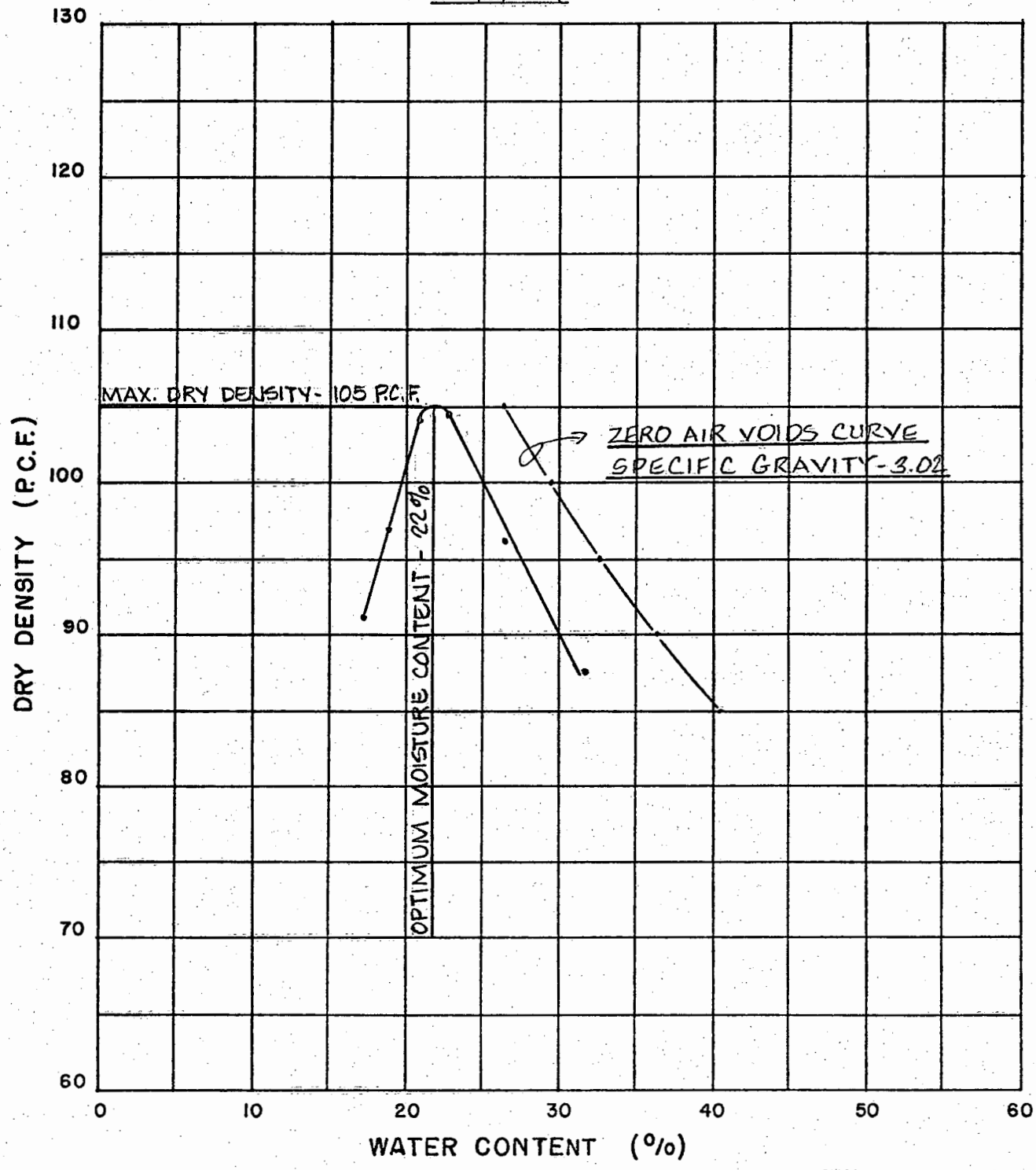
PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO.: B SURFACE

SAMPLE DESCRIPTION: MOTTLED REDDISH-BROWN CLAYEY SILT

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4"ϕ X 4.584" HIGH
HAMMER: 10 LBS. 18" DROP
LAYERS: 5
BLOWS: 25/LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 11-26-73 BY NJ

MOISTURE–DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO.: 13 SURFACE

SAMPLE DESCRIPTION: DARK BROWN CLAY

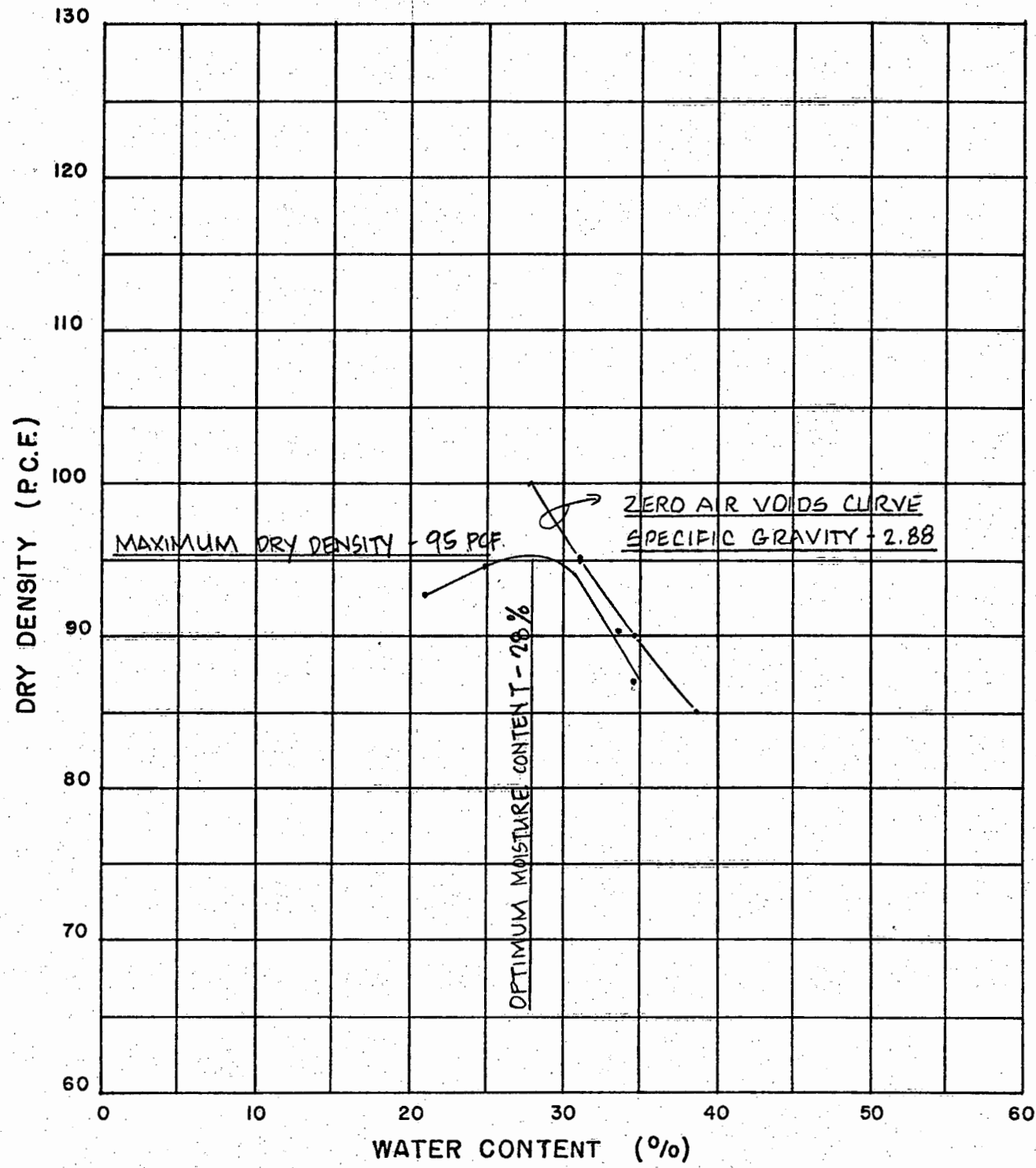
AGGREGATE: 1/4" MINUS

MOLD SIZE: 6"ϕ X 4.584" HIGH

HAMMER: 10 LBS., 18" DROP

LAYERS: 5

BLOWS: 25/LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 12-10-73 BY BT

9-470

MOISTURE–DENSITY CURVE (AASHO T-180-73I, METHOD A)

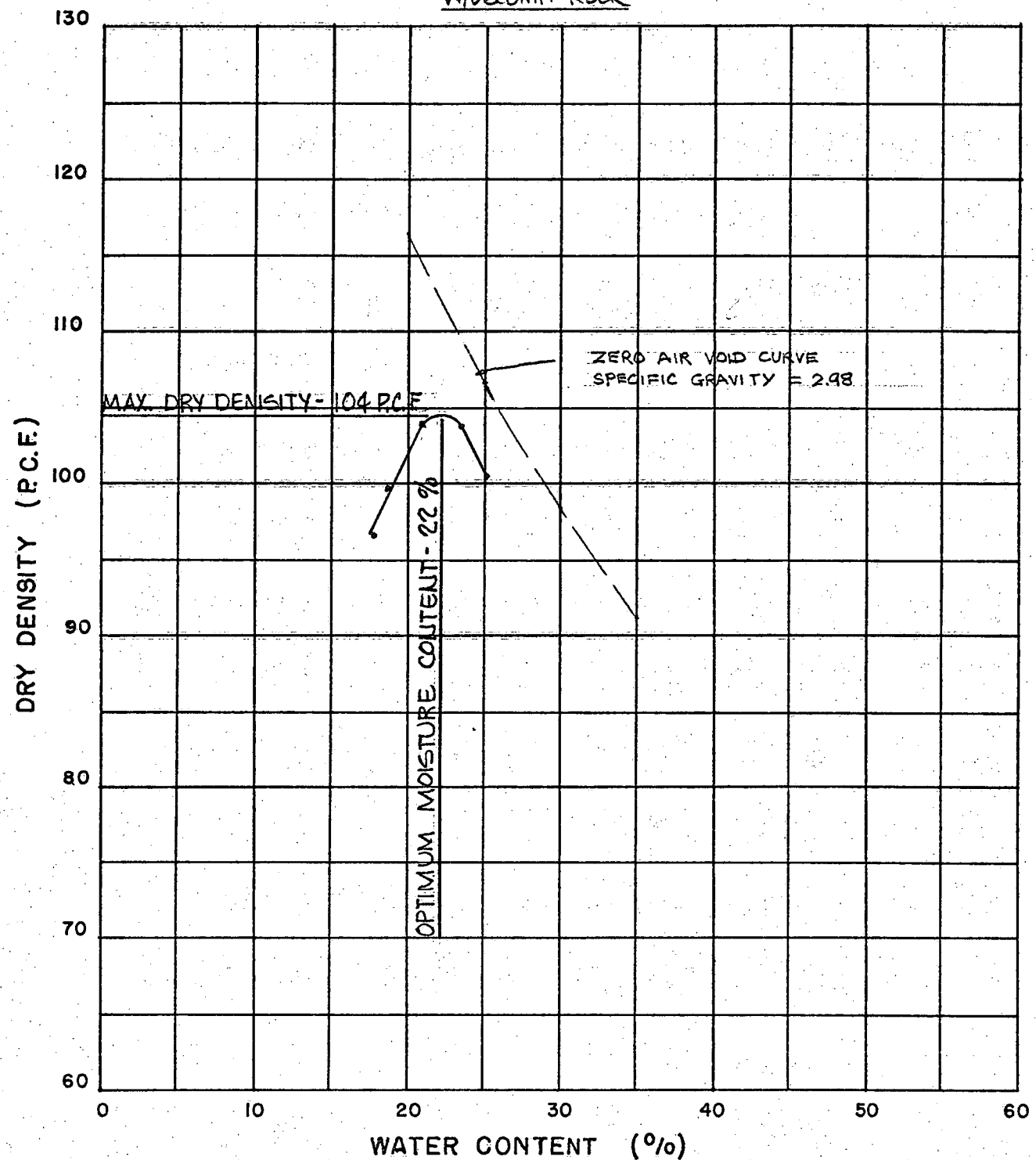
PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO.: 15 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY W/DECOMP. ROCK

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4" ϕ X 4.584" HIGH
HAMMER: 10 LBS. 18" DROP
LAYERS: 5
BLOWS: 56/LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 11-23-73 BY NI

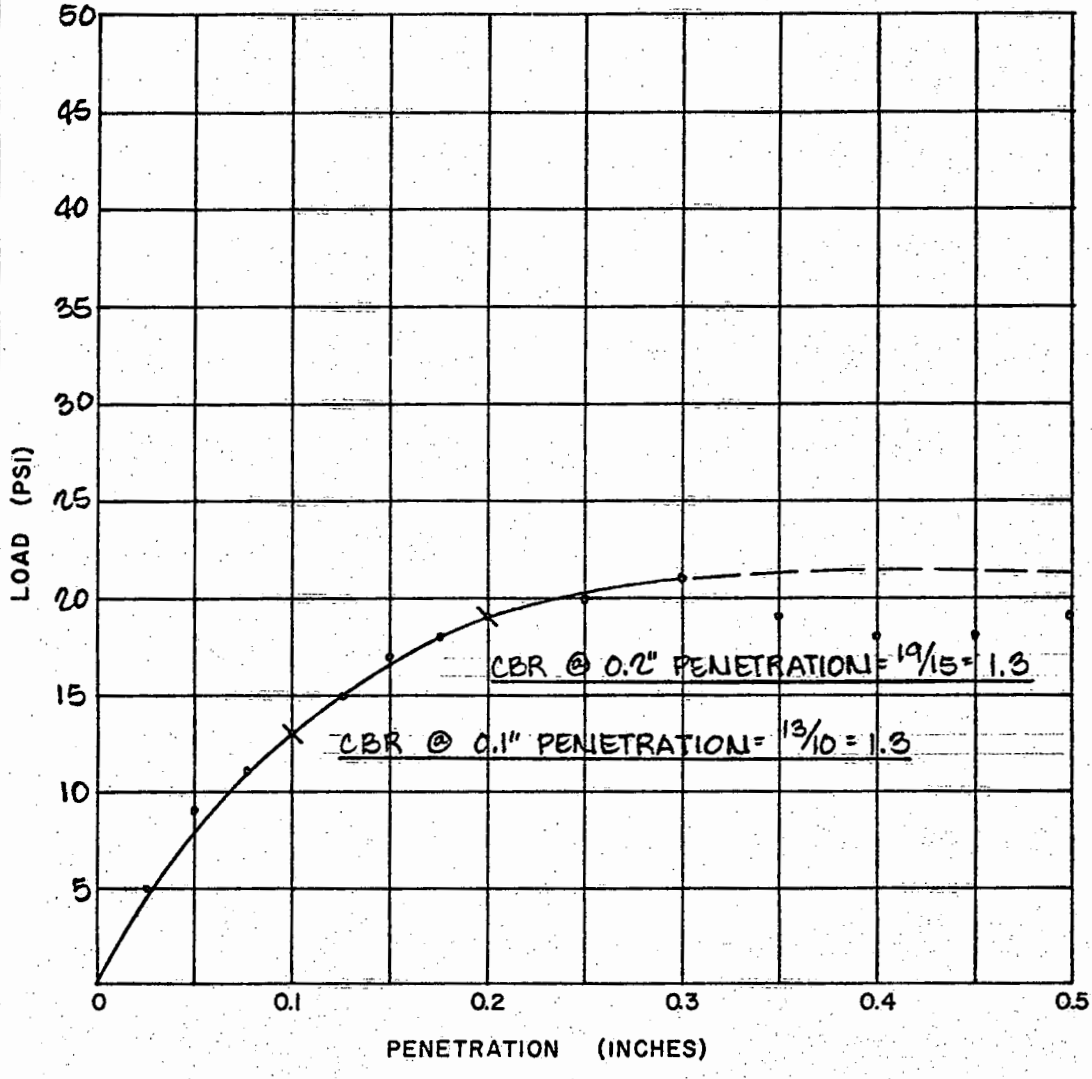
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 6 SURFACE

SAMPLE DESCRIPTION: BROWN CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025	14	5
0.050	28	9
0.075	33	11
0.100	40	13
0.125	44	15
0.150	50	17
0.175	53	18
0.200	58	19
0.250	61	20
0.300	63	21
0.350	56	19
0.400	55	18
0.450	55	18
0.500	58	19

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 18 INS.

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 25.4

MOLDING DRY DENSITY, P.C.F. 93.9

CBR @ 0.1" PENETRATION 1.3

DAYS SOAKED 4

DATE 12-3-73 BY LY

DATE 12-4-73 BY NI

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

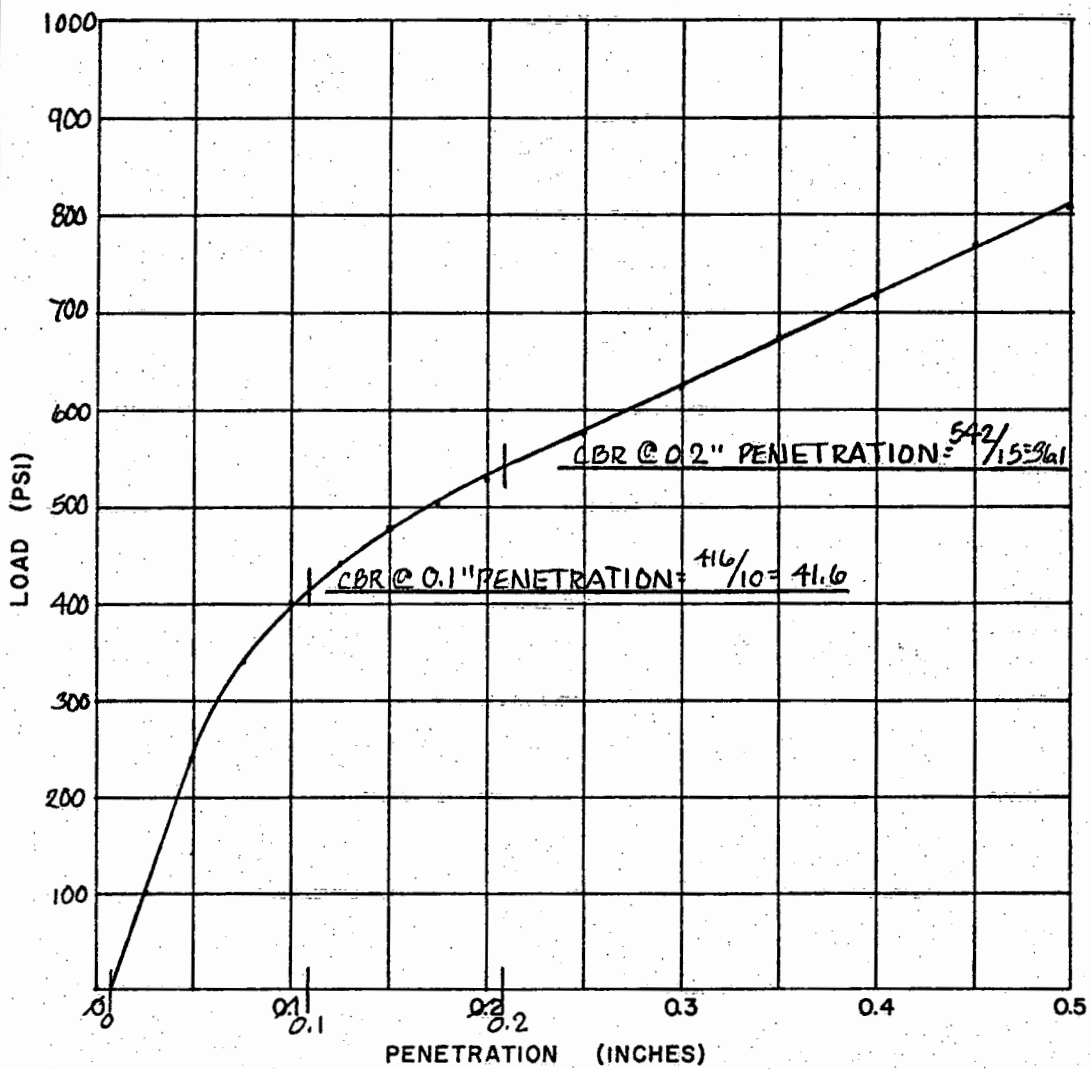
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 8 SURFACE

SAMPLE DESCRIPTION: MOTTLED REDDISH-BROWN CLAYEY SILT



ADJUSTED COORDINATES

CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	300	100
0.050	730	243
0.075	1020	340
0.100	1210	403
0.125	1325	442
0.150	1440	480
0.175	1515	505
0.200	1580	527
0.250	1730	577
0.300	1870	623
0.350	2025	675
0.400	2150	717
0.450	2300	767
0.500	2420	807

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LB.

HAMMER DROP 18 IN.

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 21.8

MOLDING DRY DENSITY, P.C.F. 104.1

CBR @ 0.1" PENETRATION 41.6

DAYS SOAKED 4

DATE 11-23-73 BY LY

DATE 11-26-73 BY JS

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

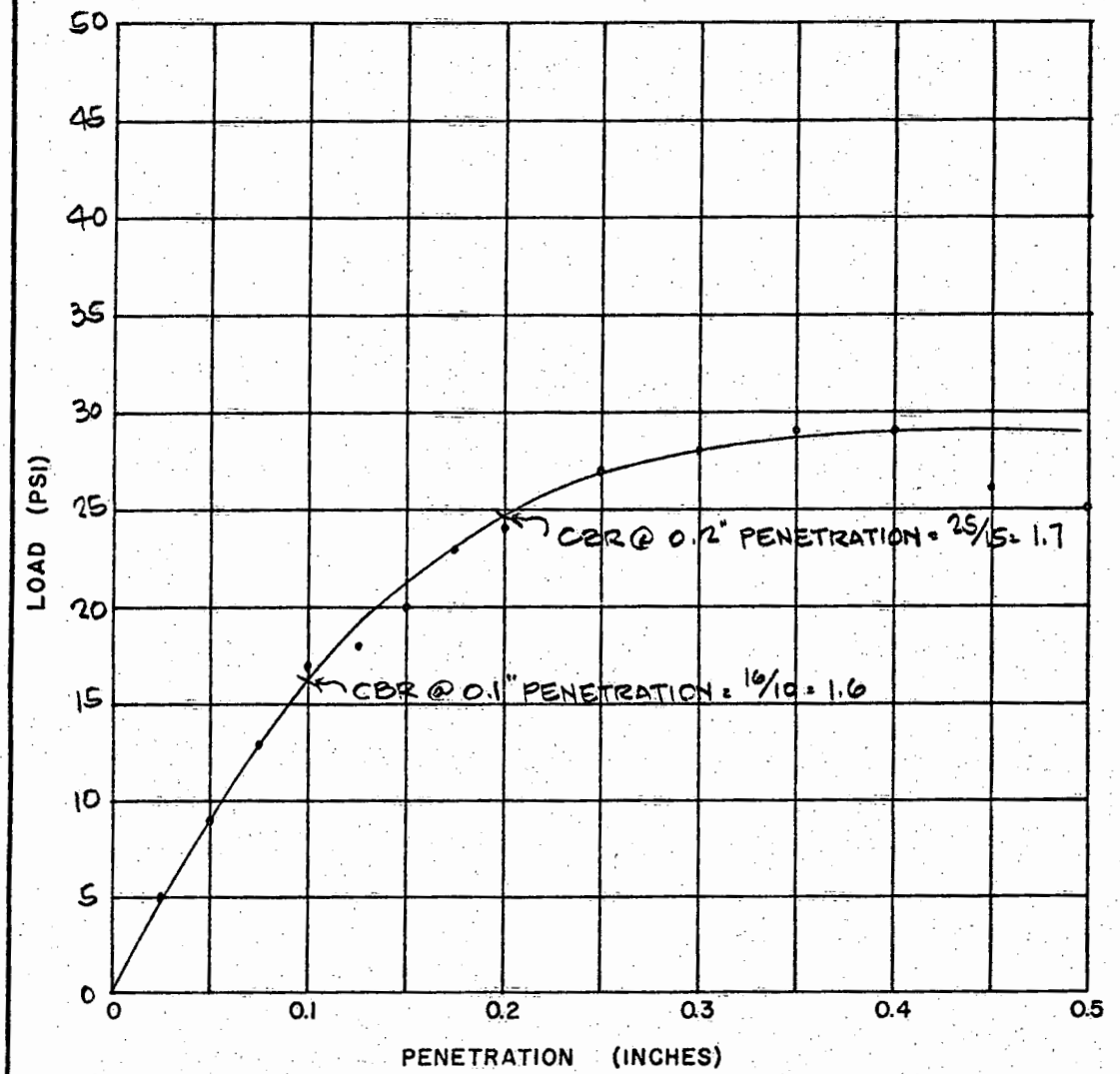
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 13 SURFACE

SAMPLE DESCRIPTION: DARK BROWN CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	15	5
0.050	27	9
0.075	38	13
0.100	50	17
0.125	55	18
0.150	60	20
0.175	68	23
0.200	72	24
0.250	80	27
0.300	84	28
0.350	86	29
0.400	86	29
0.450	78	26
0.500	75	25

AGGREGATE 3/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 30.0

MOLDING DRY DENSITY, P.C.F. 92.9

CBR @ 0.1" PENETRATION 1.6

DAYS SOAKED 4

DATE 12-11-73 BY LY.

DATE 12-11-73 BY BT.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

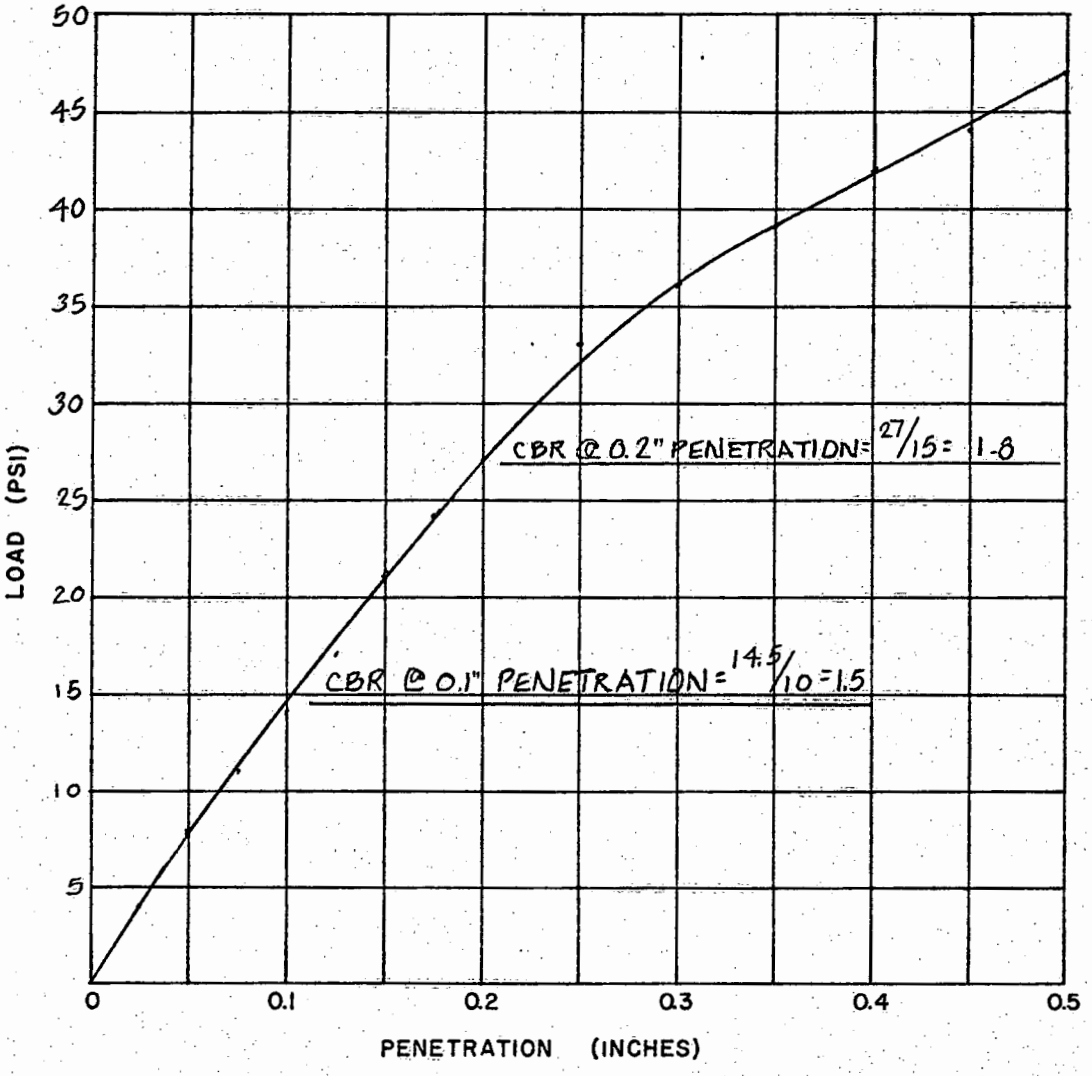
CBR TEST

PROJECT: NANAKULI SUBDIVISION-PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: #4 SURFACE

SAMPLE DESCRIPTION: BROWN CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	12	4
0.050	24	8
0.075	34	11
0.100	43	14
0.125	52	17
0.150	62	21
0.175	71	24
0.200	80	27
0.250	98	33
0.300	107	36
0.350	118	39
0.400	126	42
0.450	133	44
0.500	140	47

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LB

HAMMER DROP 18 IN.

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 20.4

MOLDING DRY DENSITY, P.C.F. 102.9

CBR @ 0.1" PENETRATION 1.5

DAYS SOAKED 4

DATE 11-24-73 BY LY

DATE 11-26-73 BY JS

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

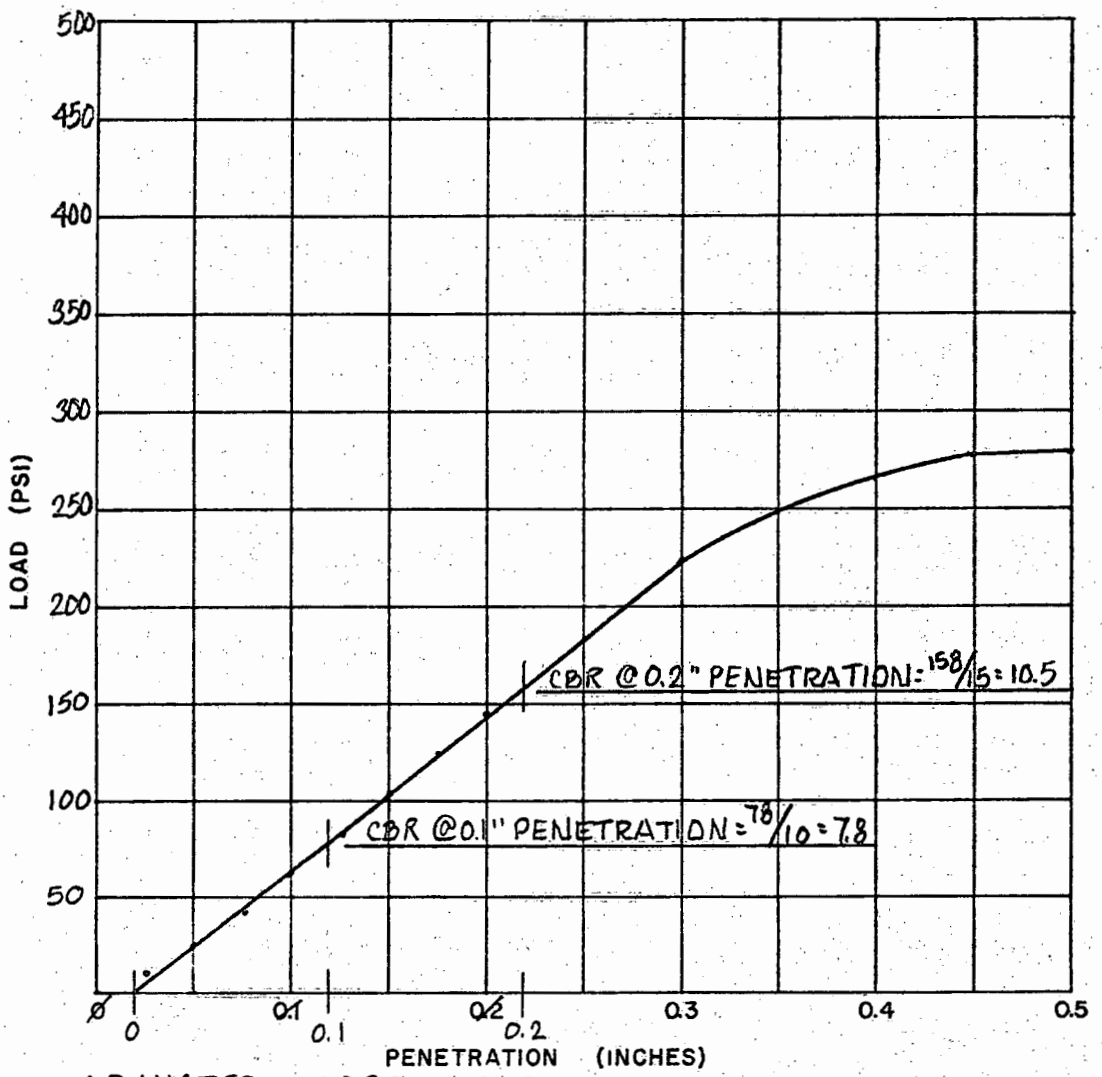
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 15 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY W/DECOMP. ROCK



ADJUSTED COORDINATES

CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	32	11
0.050	75	25
0.075	126	42
0.100	185	62
0.125	246	82
0.150	309	103
0.175	372	124
0.200	432	144
0.250	550	183
0.300	665	222
0.350	751	250
0.400	795	265
0.450	800	267
0.500	802	267

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LB

HAMMER DROP 18 IN

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 20.0

MOLDING DRY DENSITY, P.C.F. 105.0

CBR @ 0.1" PENETRATION 7.8

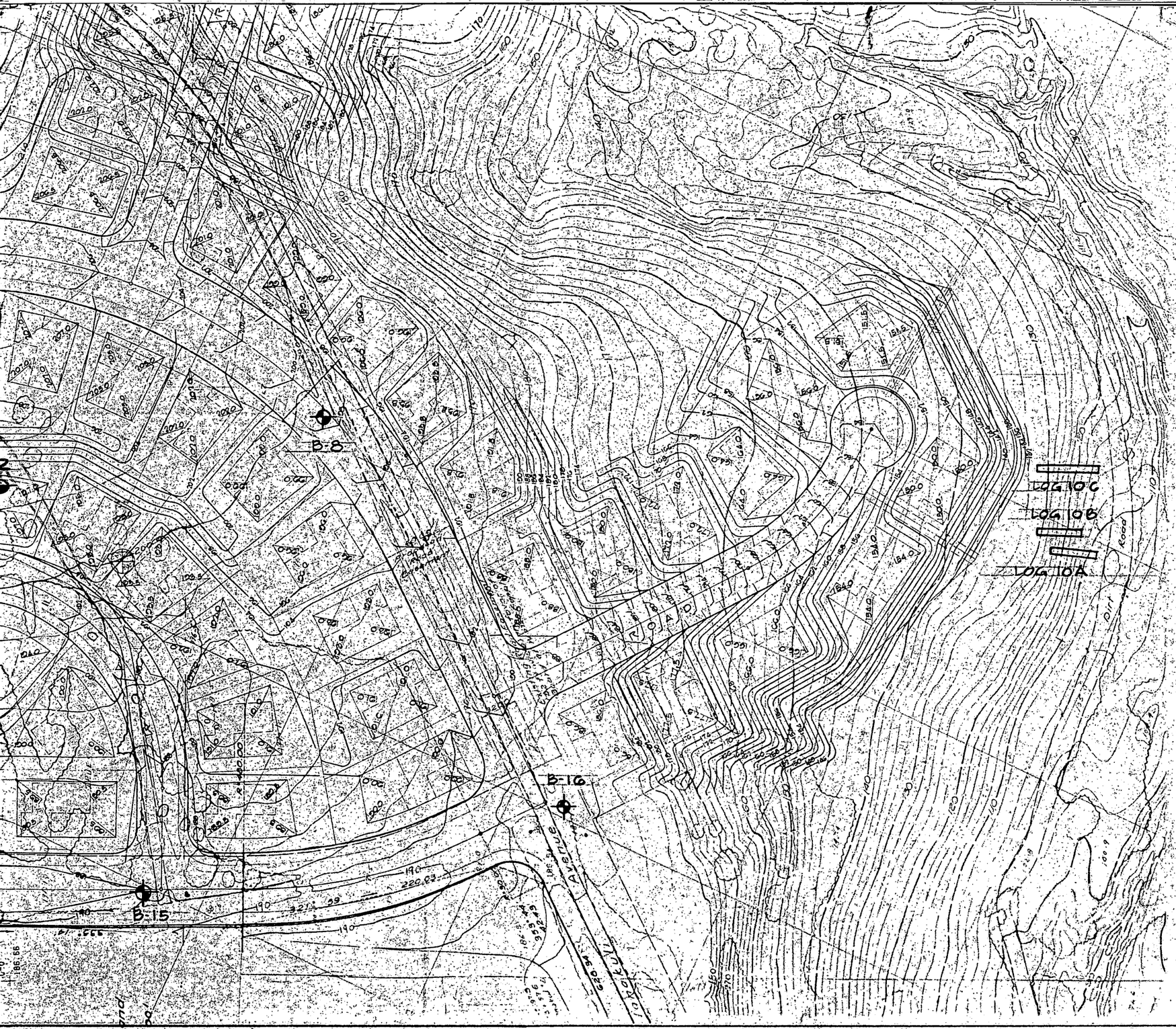
DAYS SOAKED 5

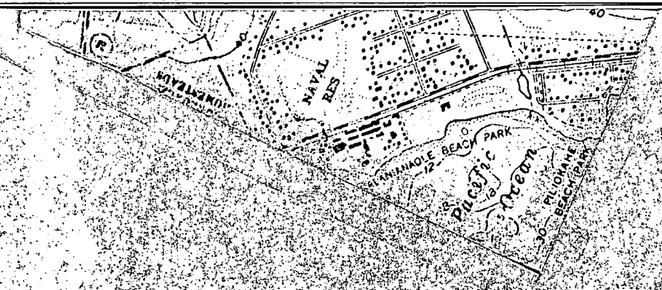
DATE 11-24-73 BY LY

DATE 11-26-73 BY JS

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

10-470





PROJECT LOCATION SKETCH

NOT TO SCALE

LEGEND

BORING

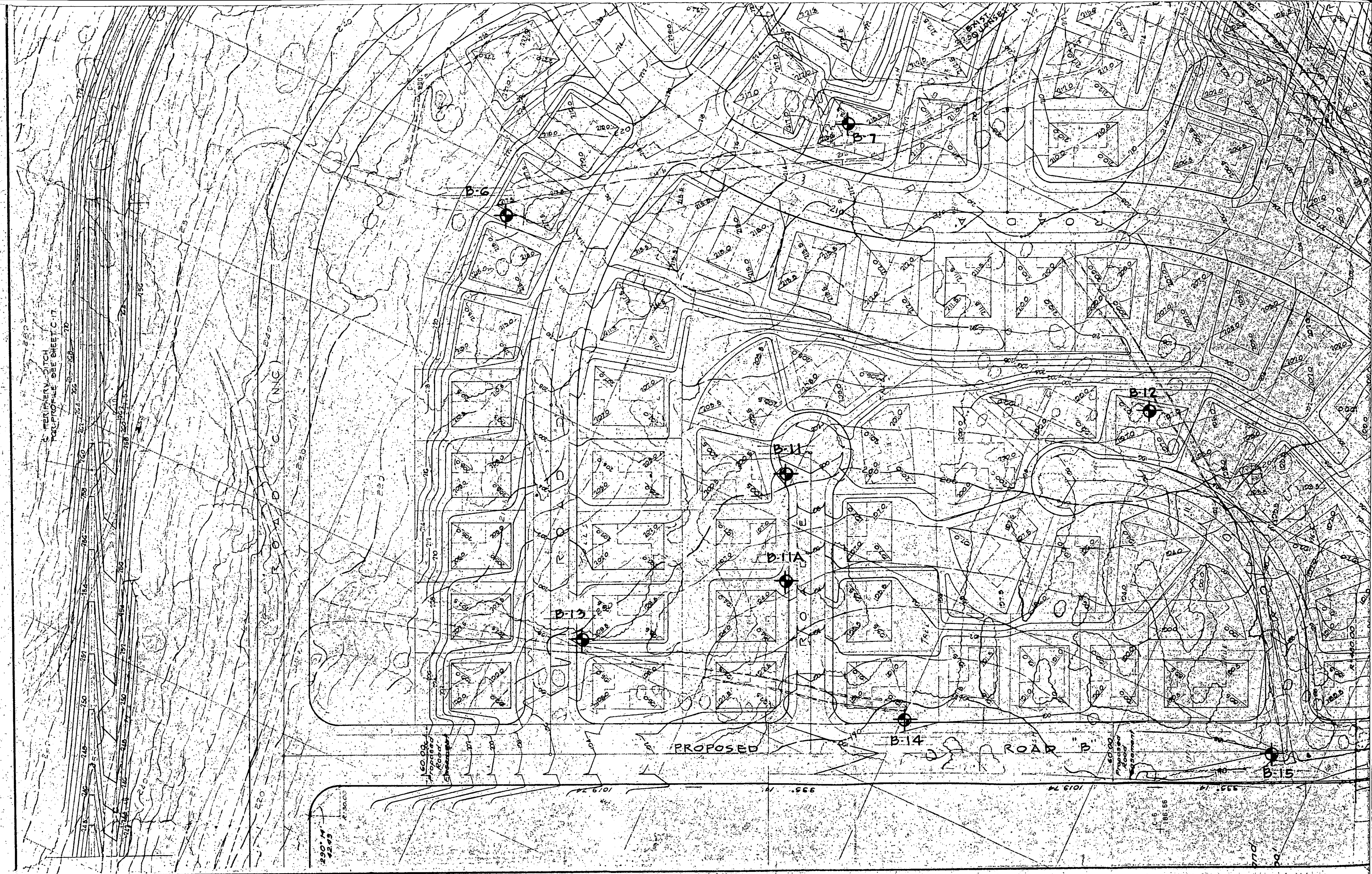
LOG OF SLOPES

BORING LOCATION SKETCH
NANAKULI SUBDIVISION PHASE I
NANAKULI OAHU HAWAII
TAX MAP KEY: 8-9-07-3

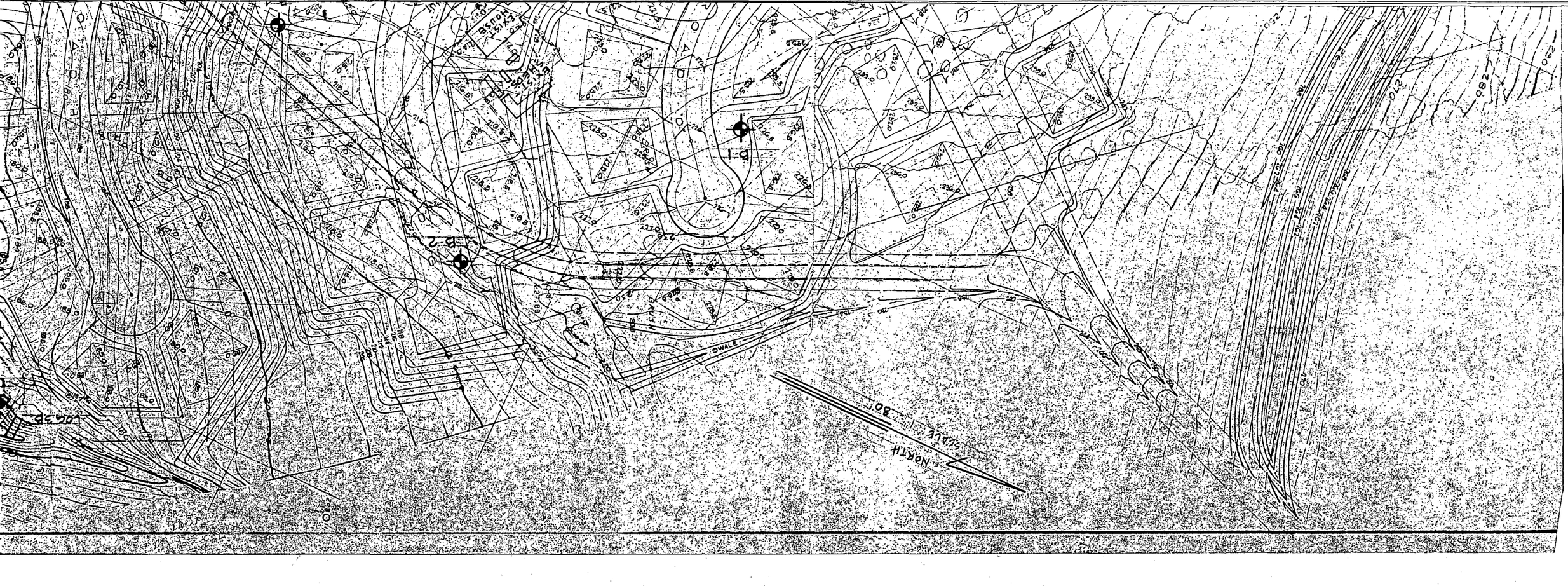
Dr. ____
Date 12/73
Rev. ____

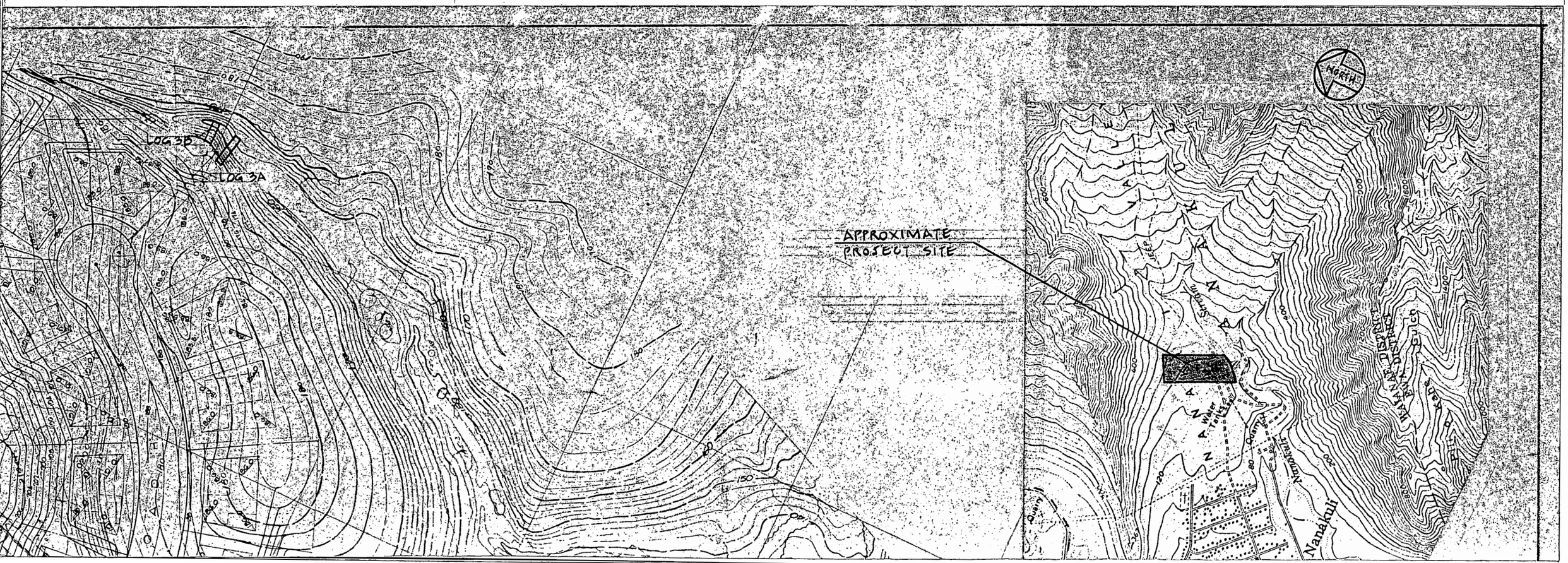
WALTER LUM ASSOCIATES, INC.
3030 WAIALAE AVE.
CIVIL ENGINEERS
PHONE 737-7931

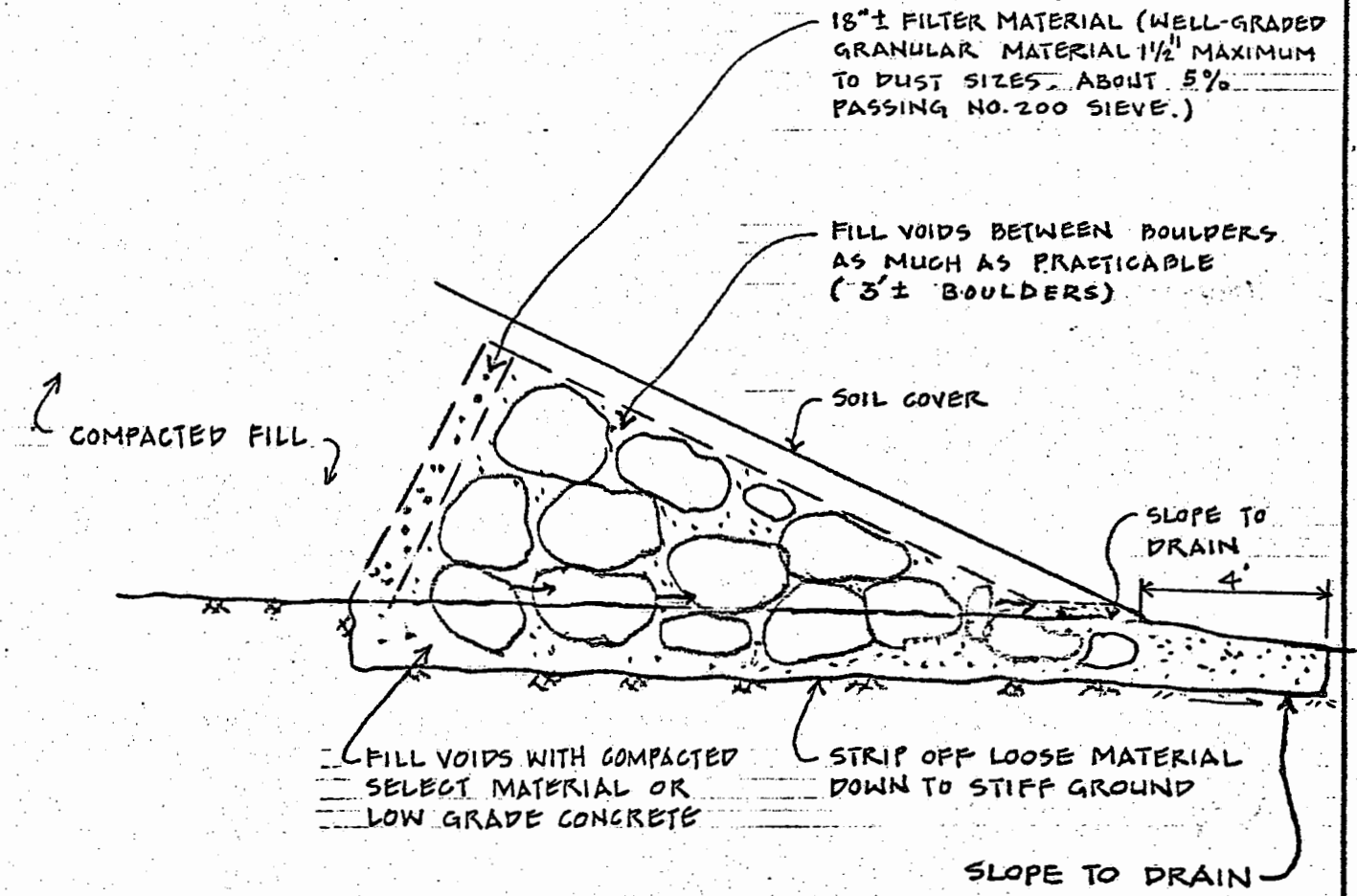
Sheet ____ of ____



B-6
B-7
B-11
B-11A
B-12
B-13
B-14
B-15
PROPOSED
ROAD "B"


B-1
B-2
DWALE
NORTH
SCALE 80'
EX. 1ST HOUSE
EX. 2ND HOUSE


LOG 3B
LOG 3A
APPROXIMATE
PROJECT SITE
NORTH
Nanakuli
Nanakuli Ave
Water Tanks
Quarry
Makaha Ridge
Makaha Ridge Trail
Peak
Gulch
Ridge
Trail



SECTION

NOT TO SCALE

FIGURE 1

PROPOSED BOULDER FILL

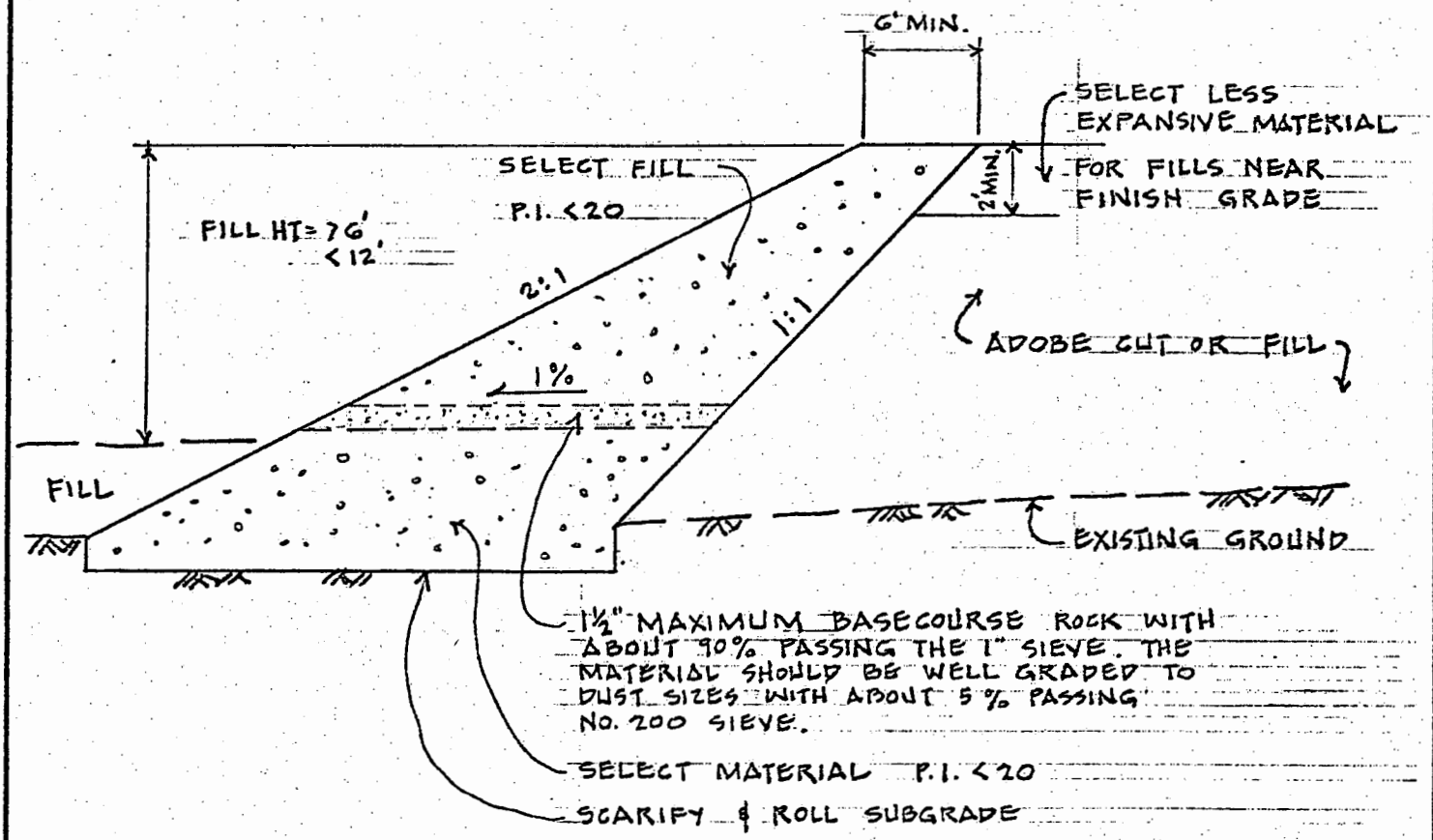
NANAKULI SUBDIVISION - PHASE I

NANAKULI, OAHU, HAWAII

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

DECEMBER, 1973



SECTION

NOT TO SCALE

FIGURE 2

TYPICAL SLOPE TREATMENT FOR CUTS & FILLS IN ADOBE

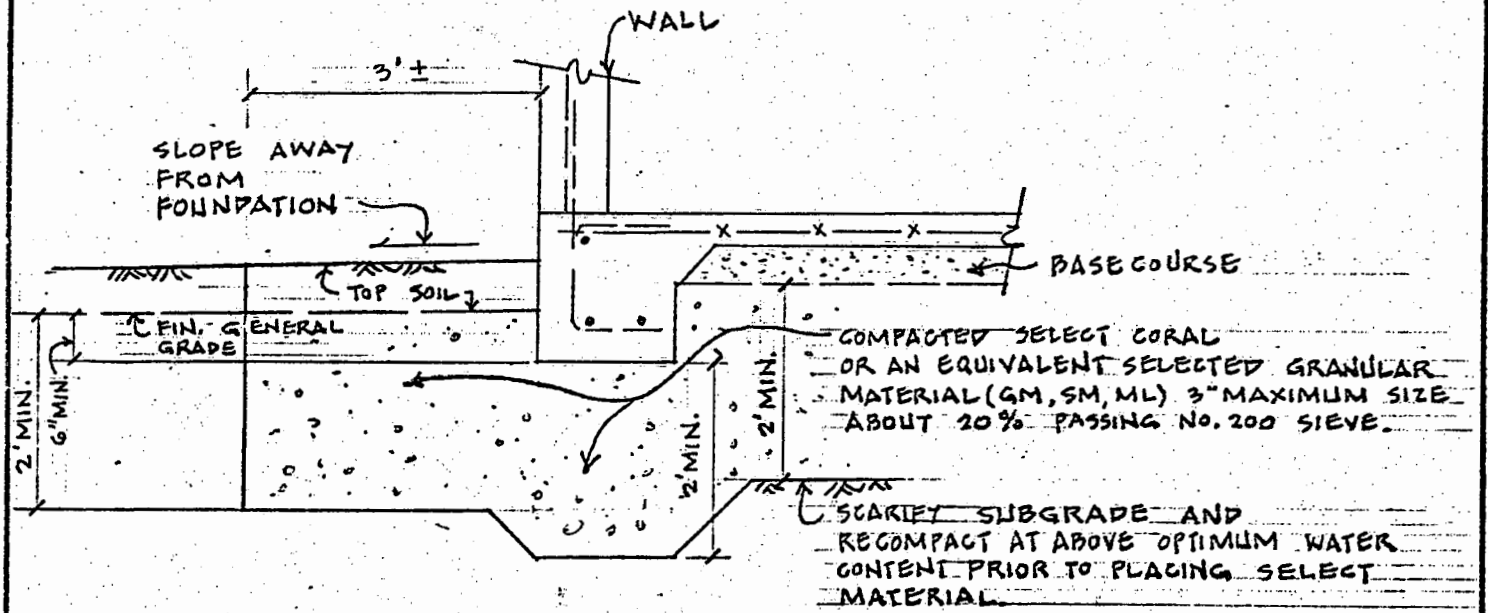
NANAKULI SUBDIVISION - PHASE I

NANAKULI, OAHU, HAWAII

WALTER LUM ASSOCIATES, INC.

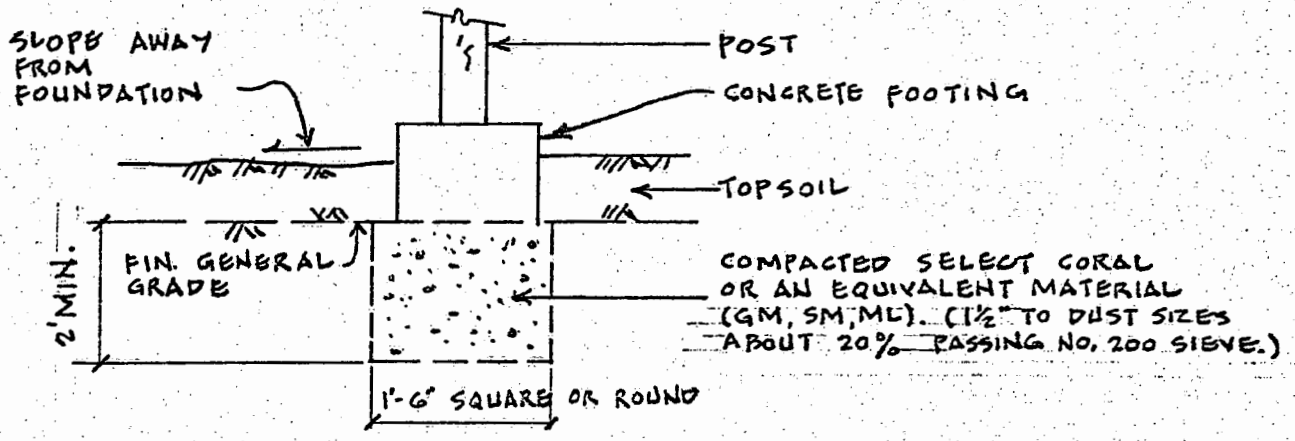
CIVIL, STRUCTURAL, SOILS ENGINEERS

DECEMBER, 1973



PROPOSED FOOTING FOR SLAB-ON-GROUND ON EXPANSIVE SOIL

NOT TO SCALE



PROPOSED FOOTING FOR POST-AND-BEAM ON EXPANSIVE SOIL

NOT TO SCALE

FIGURE 3
PROPOSED FOOTING DETAILS
FOR LIGHT RESIDENTIAL STRUCTURES
ON EXPANSIVE SOILS
NANAKULI SUBDIVISION - PHASE I
NANAKULI, OAHU, HAWAII

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DECEMBER, 1973

LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse, changed conditions, and changes in the state of the art of soil engineering.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.